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TOGAF for Agile SOA Modelling

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Being motivated by the requirement of short evolution period, as well as business & IT alignment for the next generation of agile SOA enterprise architecture, this paper introduces a BPM+SOA-aligned modelling approach with iterative agile modelling process, based on The Open Group Architecture Framework (TOGAF) for SOA agile enterprise architecture development. Through content entity analysis, semantical aligning mechanism on basis of meta-model layer is applied to serve as the foundation of a TOGAF approach, bridging the gap between business architecture and information system architecture models.

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1.Introduction

John A. Zachman, an IBM architect, put forward the Zackman framework as the first theoretical framework for enterprise architecture, in his article “A Framework for Information Systems Architecture” (1987)[1]. The "enterprise" here refers to the organization with a common vision, and it can also be interpreted as a company, a government agency, or a collection of multiple organizations. Since then, the academic and industrial communities have taken effort and made progress to find practical methodologies for design and evolution of enterprise architecture for complex interoperated systems in the past three decades [1, 2]. As a top-level design method concerning business strategy, information technology and resource management, the enterprise architecture is adopted in multinational corporations and government agencies worldwide.

Due to the globalization of world economy and the increasing competition in open markets, enterprises are constantly challenged by the dynamic market environment. They need to utilize a contemporarily agile way-of-work, in which the alteration of business processes and upgrade of hardware systems become routines throughout the enterprise lifecycle. Traditional IT systems cannot support frequent alteration and expansion of business process, which can be long and expensive. Then new requirements of the enterprise architecture design are raised: enterprises need a more agile architecture.

Agility is listed as the first of the 6 features that characterize the new generation of enterprise architecture, as summarized by Gill in [3]. Compared with the traditional enterprise architecture, agile architectures are more flexible (able to adapt to expected or unexpected changes at any time) and speedy (able to accommodate expected or unexpected changes rapidly). To fulfil these features, 2 criteria for architecture development should be followed:

(1) Agile evolution, which means that the overall iteration of the architecture development should be carried out more frequently.

(2) Alignment of business and IT, which means that the IT application systems should be rapidly matched up when business processes are adjusted or scaled-up.

An overall design and planning is mandatory [4, 5] for ailment. The most proposed approaches of agile architecture design are combined with methods from Business Process Management (BPM) [6], Service Oriented Architecture (SOA) [3, 7], and the agile development methods for software engineering, as mentioned in [8, 9]. There have already been some successful applications separately [10]. Whereas, how to implement enterprise SOA agile architecture design and development is still in need of lots of researches with systematic methodology.

The development approach is driven by agile enterprise architecture , while integrating those approaches above and The Open Group Architecture Framework (TOGAF) [11] , which is one of the most popular enterprise architecture frameworks. The applicability and effectivity of the combined methods are demonstrated from the following two perspectives.

First, agile evolution is achieved by the integration of SOA and TOGAF, binding the scalability of SOA and agile development methods included in TOGAF. Instead of traditional waterfall approach, agile development methods focus on developing and delivering working versions in small iterations with minimal upfront design. Its iterative and incremental nature leads to short feedback loops resulting in improved stakeholder collaboration and the ability to deal with changing requirements. SOA enables enterprises to be more responsive and more flexible through the reuse and integration of collaborative service components, system resource, and legacy assets. Within the last decade, the information technology community has embraced

SOA, which improves the reuse of organization's applications and leads to a greater efficiency of IT investments.

Second, the alignment of business and IT is achieved by the integration of BPM and SOA [8, 12]. A successful agile SOA design must be a result of cooperation between IT technician and business process manager. BPM provides a structured approach that models the interaction between an enterprise's human and machine tasks, as well as promotes organizational agility and supports users to drive process changes and innovation. In BPM, business processes are viewed as assets to be managed, designed and continuously improved to enhance business agility and operational performance. SOA is "an architectural style for creating an enterprise's IT architecture that exploits the principles of service-orientation to achieve a closer relationship between the business and the information systems supporting the business" [13]. BPM+SOA incooperates business and IT, which ensures the optimization of business processes as well as IT systems to increase the efficiency, flexibility, reduction of risks and consistency.

In combination with iterative modelling processes from TOGAF, modelling approaches of BPM+SOA for agile SOA development is proposed to deal with issues caused during the agile evolution and business & IT alignment.

2. TOGAF Modelling for Agile Architecture

2.1 TOGAF

TOGAF is proposed by The Open Group and revised in [11], and soon becames one of the most well-known frameworks and standards published by different organizations [14]. With the promotion of the international manufacturers (IBM, HP, SUN, etc.), TOGAF is currently the leading architecture framework, which is being widely used by 73% of international corporations[15]. In China, an increasing number of large-scale businesses like Huawei, State Grid have been following the TOGAF framework and methods to build the enterprise architecture [16]. Yuliana [17] implemented the SOA agile architecture modelling method based on TOGAF in the context of a mining enterprise architecture modelling, iteratively developed the baseline architecture and the target architecture, and emphasized the business & IT alignment during the iteration process.

There are two common reference standards included in TOGAF for the process and content of the architecture development: a complete set of architecture development methodology named Architecture Development Method (ADM) and a set of meta-model frameworks defining the architectural content named Architecture Content Framework (ACF) [11, 18].

ADM is a holistic, reliable and effective iterative development process implemented in each phase, to develop the enterprise architecture and meet the strategic requirements. ADM defines the enterprise architecture design as an iterative development circulation from business architecture to information architecture, and also specifies the inputs/outputs for every phase [11]. As shown in Figure 1, ADM divides the enterprise architecture modelling process into 8 phases from A to H, apart from the usually nonrecurring preliminary process and the continuously executed requirement management phase in the center. The ADM is iterative over all, within, and between phases. The whole iteration cycle of ADM is the outer layer iteration, and several inner layer iterations can also be included in the ring cycle.

ACF is defined as a formalized abstract content structure at the meta-model level in order to ensure the consistency of the content in the holistic modelling process [11]. A meta-model is generally defined as a "model of models". ACF, as a kind of ontological meta-model, includes

the definition of the common architecture content entities as well as their relations. By defining, constructing and presenting the model instances on the basis of a common ontology, ACF can help a modeler to ensure the semantic consistency and thecompleteness of models.

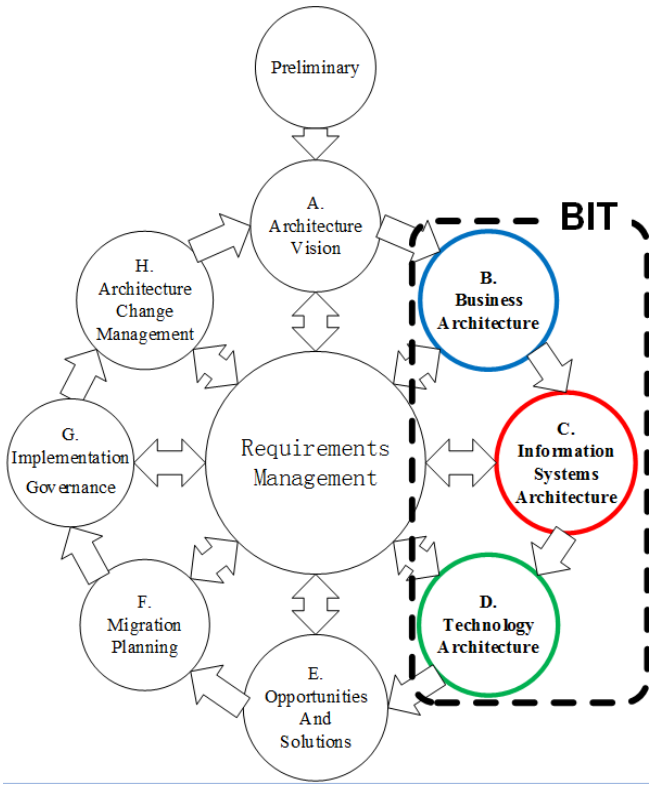

Figure 1 :The BIT Architectures as the Core of ADM

2.2 BIT: the Core of ADM

The holistic description of enterprise architecture in TOGAF is classified into 3 architectural viewpoints in the ADM: Business Architecture, Information Systems Architecture and Technology Architecture [11], with the abbreviation as BIT architecture, which depicts business processes, information services integration and technical standards in different phases. The three corresponding architecture-modelling phases constitute the core of ADM, as shown in Figure 1. And the corresponding BIT content meta-model takes respective one part of ACF, including the core and extension content entities as well as the mutual relations, as shown in Figure 2. The architecture development process based on TOGAF is the iterative design and development of BIT architecture models by following ADM for life cycle, driven by the architecture vision, and centering around the architecture requirements.

Business Architecture (B) describes the strategy, structure, activities, processes, rules, and related information flows of a business. In the modelling of business architecture, BPM modelers recognize the interoperable relationship between each enterprise and the internal process as a business node. The content meta-model of Business Architecture contains 6 core content entities (Organization-Unit, Actor, Role, Process, Function, and Business-Service) and 10 extension entities (as shown in Figure 2) in ACF. Instead of interactions within system resources and legacy systems, Business Architecture focuses on business processes and collaboration relationships.

Information Systems Architecture (I) provides a blueprint for the SOA systems to be deployed and their relationships with the core business processes, including the service architecture, service contract, operations, I/O parameters, and service interface of SOA

information system architecture that support the Business Architecture. The system nodes and the underlying resources are assigned to the BPM business process by SOA, which flexibly changes or more easily reconstitutes the BPM business process through service integrations with standard interfaces and the feature of loose coupling, in order to meet the new business needs of the enterprise. The content meta-model of Information Systems Architecture contains 2 core content entities (Logical-Application-Component and Data-Entity) and 4 extension entities (as shown in Figure 2) in ACF. With Data-Entity relating to the Business-Service, which is one of the core content meta-model entities of Business Architecture.

Technology Architecture (T) describes the underlying system resources, infrastructures and technical standards of the enterprise architecture. For instance, the network communication, the distributed system, and information security are used to support both Business and Information Systems Architectures. The content meta-model of Technology Architecture contains 2 core content entities (Platform-Service and Physical-Technology-Components) and 1 extension entity (as shown in Figure 2) in ACF. Platform-Service and Physical-Technology-Components which are related to the Business-Service and Logical-Application-Component, are included in the core content meta-model entities of Business and Information Systems Architecture.

Obviously, those three architectural viewpoints of BIT are combined, as a whole through the underlying association in ACF and are relative and supportive to each other. By selecting the appropriate modelling language and mapping-related modelling elements, BIT architectures configured in the approach combining BPM with SOA to keep alignment of business and IT.

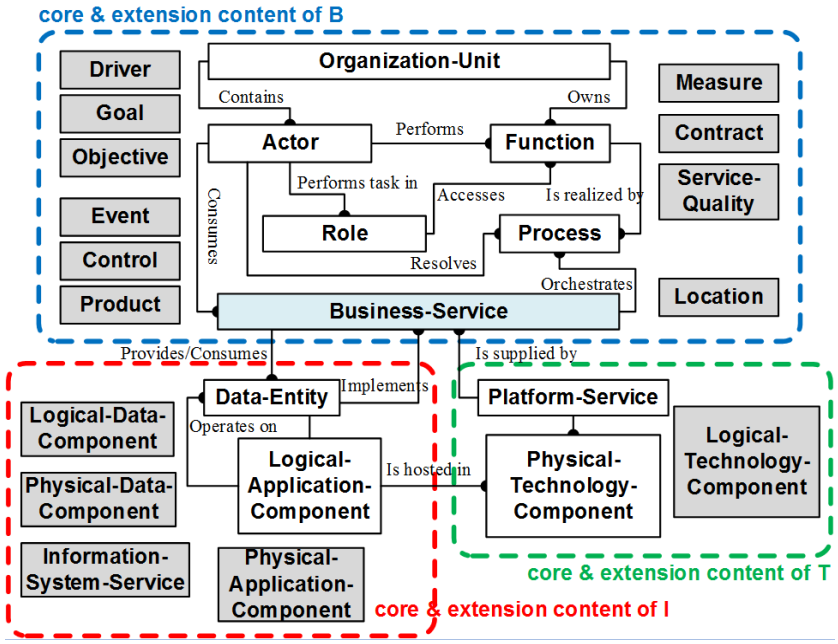

Figure 2:BIT Architecture Content Meta-Models in ACF

2.3 Separation and Alignment of BIT based on ACF

Different from symbolic meta-models, ACF is one type of ontological meta-models mentioned in [19], which makes sense on the semantic level. ACF takes full account of the architecture content, which needs to be addressed, including business processes, data, rules, nodes, etc., with inherent constraints and associations of the content. ACF also serves as a "glue", not only between but also within each viewpoint of architecture models.

The ontological meta-models particularly play a crucial role in architecture development. Analogously, the Department of Defense Architecture Framework (DoDAF) version 2.0-another framework supported by the US Department of Defense, also established the content meta-model named the Department of Defense Meta-Model (DM2) to play the same role. Based on DM2 to promote consistency, data-centered modelling is applied to describe various dimensions of the system architecture through a series of models from different modelling viewpoints.

Given the adoption of ACF for TOGAF, the criteria of "separation" and "alignment" of BIT architecture modelling based on ACF is proposed.

2.3.1 Separation of BIT Modelling Viewpoint

Separating modelling concerns is to limit each set of description models to specified viewpoints for different abstraction, to ensure the intelligibility and interactivity of the architecture models for stakeholders. Therefore, ACF is divided into 3 parts, which are mainly independent but partially connected in meta-model, according to the 3 modelling phases of BIT, as shown in Figure 1. The modelling phases of BIT architectures follow the instantiation description process by adding scenarios, which is based on the range of three different parts of content meta-models respectively.

2.3.2 Alignment of BIT Modelling Semantics

As the mechanism of semantic alignment of the BIT architecture models, model instances of BIT differ from modelling languages in the way of description, but map between model elements in respect of the association defined at ACF meta-model level. As shown in Figure 2, the content entity Business-Service in ACF plays a key role, not only associating with the other entities of each BIT content meta-models, but also connecting with each other. In this paper, Business-Service is employed as the link among BIT architecture models at the meta-model level. Instead of being modeled independently, the semantic mapping and checking relations will be established based on Business-Service among the model elements in the phases of BIT architecture modelling, as a criterion for semantic alignment.

3. Conclusions

In this paper, an iterative approach is introduced on basis of TOGAF, for the next generation of agile enterprise architecture that is generated by SOA aligned modelling. BPM and SOA complement each other with reciprocal benefits by aligning more directly IT resources with business goals. The future research will focus on the practical modelling methodology of BIT architecture models for agile SOA, which separate in viewpoints and align in semantics. More detailed mapping rules, associated processes and verification methods for model consistency concerning BPMN and SoaML model elements will be further studied.

References

[1] J. Lapalme, A. Gerber, A. Van der Merwe, J. Zachman, M. De Vries, and K. Hinkelmann, "*Exploring the future of enterprise architecture: A Zachman perspective*," Computers in Industry, vol. 79, pp. 103-113, 2016.

[2] M. Lankhorst, Enterprise Architecture at Work: *Modelling, Communication and Analysis*. Berlin: Springer, 2013.

[3] A. Q. Gill, "*Applying agility and living service systems thinking to enterprise architecture*," International Journal of Intelligent Information Technologies, vol. 10, pp. 1-15, 2014.

[4] A. Q. Gill, "*Adaptive enterprise architecture driven agile development*," in 24th International Conference on Information Systems Development, Harbin, 2015, p. 9.

[5] A. Q. Gill, "*Learning Enterprise Agile Software Engineering: Scaling Agility at the Enterprise Level*," in 24th Australasian Software Engineering Conference, 2015, pp. 148-154.

[6] S. Kruba, S. Baynes and R. Hyer, "*BPM, Agile, and Virtualization Combine to Create Effective Solutions*," International Journal of Advanced Computer Science and Applications, vol. 3, pp. 140-6, 2012.

[7] M. Shahrbanoo, M. Ali and M. Mehran, "*An Approach for Agile SOA Development using Agile Principals*," International Journal of Computer Science and Information Technology, vol. 4, pp. 237-44, 2012.

[8] A. Q. Gill, "*Agile enterprise architecture modelling: Evaluating the applicability and integration of six modelling standards*," Information and Software Technology, vol. 67, pp. 196-206, 2015.

[9] N. Bernal Wilson and L. A. Carmenza, "*Agile Methodology to Develop Architecture of Information and Knowledge in Organizations (MADAIKE)*," International Journal of Machine Learning and Computing, vol. 5, pp. 153-9, 2015.

[10] S. Hanschke, J. Ernsting and H. Kuchen, "*Integrating agile software development and enterprise architecture management*," in 2015 Annual Hawaii International Conference on System Sciences, Kauai, 2015, pp. 4099-4108.

[11] The Open Group, "*TOGAF Version 9.1*,": The Open Group, 2011.

[12] F. A. Cummins, "*BPM meets SOA: A new era in business design*," in Handbook on Business Process Management 1: Introduction, Methods, and Information Systems Berlin: Springer, 2015, pp. 531-555.

[13] G. Matei, "*SOA and BPM: a Partnership for Successful Organizations*," Informatica Economica, vol. 15, pp. 39-54, 2011.

[14] A. Ferrugento and A. Rocha, "*Evolution of methodological proposals for the development of enterprise architecture*," Advances in Intelligent Systems and Computing, vol. 353, pp. 351-359, 2015.

[15] M. Clarke, J. G. Hall and L. Rapanotti, "*Enterprise Architecture: A Snapshot from Practice*," International Journal of IT/Business Alignment and Governance, vol. 4, pp. 1-10, 2013.

[16] L. Bo and C. Hongjun, "*Application research on the informationization architecture of diversified state-owned enterprise groups based on TOGAF*," Computer Modelling and New Technologies, vol. 18, pp. 741-747, 2014.

[17] R. Yuliana and B. Rahardjo, "*Designing an agile enterprise architecture for mining company by using TOGAF framework*," in 2016 4th International Conference on Cyber and IT Service Management, Bandung, 2016.

[18] Z. Tao, Y. Luo, C. Chen, M. Wang, and F. Ni, "*Enterprise application architecture development based on DoDAF and TOGAF*," Enterprise Information Systems, vol. 11, pp. 627-651, 2017.

[19] L. Yiming and L. Dong, "*An Ontological Meta-model Framework for Implementation of IEC 61968*," Przeglad Elektrotechniczny, vol. 88, pp. 232-5, 2012.